

**Hotel Model Revision
Direction for SRA
October 14, 2008**

Updates to the 9/26 version of this document have been made based on the EPA/SRA meeting of 10/9/08. These changes serve to clarify points of questions. They are all rare presented in Red.

Objective

This document provides all information on the revised benchmarking methodology for the Hotel model, which is to be updated in *February* 2009. The benchmarking methodology described herein should be applied within both Portfolio Manager and Target Finder. As this is an existing model, full integration with the automated benchmarking services is essential. Also, EPA will need to review and approve a score change report to assess the impact of these changes prior to the *February* release.

Timeline

Final technical direction to SRA	September 26, 2008
SRA/EPA meeting to review direction document	<i>October 9, 2008</i>
Score change report delivered to EPA	<i>November 12, 2008</i>
EPA approval of score change report	<i>November 25, 2008</i>
Final public release date	<i>February 23, 2009</i>

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I. Attributes, definitions, and default values

This updated Hotel model will require *seven* attributes to be entered by Portfolio Manager users. This section details the definitions and user requirements for these attributes.

Hotel definition

Hotel applies to buildings that rent overnight accommodations on a room/suite basis, typically including a bath/shower and other facilities in guest rooms. The total gross floor area should include all interior space, including guestrooms, halls, lobbies, atria, food preparation and restaurant space, conference and banquet space, health clubs/spas, indoor pool areas, and laundry facilities, as well as all space used for supporting functions such as elevator shafts, stairways, mechanical rooms, storage areas, employee break rooms, back-of-house offices, etc.

EPA will no longer provide different hotel amenity categories. There should be one category: Hotel.

Required attributes

There are *seven* required attributes for the Hotel model. This list is *not* the same as the list of attributes currently collected for the five hotel amenity categories. The text provided in this list includes the definitions that should be applied in Portfolio Manager and Target Finder Help, and on the website, as appropriate.

1. Gross Floor Area

- a. Definition – The total gross floor area is measured between the principal exterior surfaces of the enclosing fixed walls and includes all supporting functions. The total gross floor area should include all interior space, including guestrooms, halls, lobbies, atria, food preparation and restaurant space, conference and banquet space, health clubs/spas, indoor pool areas, and laundry facilities, as well as all space used for supporting functions such as elevator shafts, stairways, mechanical rooms, storage areas, employee break rooms, back-of-house offices, etc. The total gross floor area should not include covered walkways, balconies, or out-door pools. Also note the following:
 - i. Existing atriums should only include the base floor area that they occupy
 - ii. Interstitial (plenum) space between floors should not be included in total.
- b. Note – This definition is a slight variation on the standard definition, specifically to include information on functions typical at hotels (e.g. banquet areas).
- c. Model Calculation – Floor area does not appear as its own unique term in the model. However the model is based on EUI, and a number of model variables are presented in “density” format: number of rooms per 1,000 square foot, number of workers per 1,000 square foot and number of commercial refrigeration units per 1,000 square foot.

- d. Verification Question – Is this value the total gross floor area as measured between the principal exterior surfaces of the enclosing fixed walls and including all supporting functions? The total gross floor area should include all interior space, including guestrooms, halls, lobbies, atria, food preparation and restaurant space, conference and banquet space, health clubs/spas, indoor pool areas, and laundry facilities, as well as all space used for supporting functions such as elevator shafts, stairways, mechanical rooms, storage areas, employee break rooms, back-of-house offices, etc. The total gross floor area should not include covered walkways, balconies, or out-door pools. Also note that existing atriums should only include the base floor area that they occupy. Interstitial (plenum) space between floors should not be included in the total.

2. Number of Rooms

- a. Definition – The total number of hotel rooms available within a given hotel property, including occupied rooms, non-occupied rooms, rooms in the process of being renovated, and permanent house use. This is the number of rooms typically found in a travel guide that describes specific hotels and general features, including the number of rooms.
- b. Note – This is a current variable for all hotel amenity categories.
- c. Model Calculation – The model uses the room density (the number of rooms per 1,000 square foot) to predict the source EUI at a hotel.
- d. Verification Question – Does this number represent the total number of hotel rooms available within the hotel property, including occupied rooms, non-occupied rooms, rooms in the process of being renovated, and permanent house use? This is the number of rooms typically found in a travel guide that describes specific hotels and general features, including the number of rooms.

3. Workers on Main Shift

- a. Definition – Workers on Main Shift should reflect the average number of workers that are present during the primary shift (that is, the shift with the most workers). Note: this is not the total number of staff employed at the property. For example, if there are three daily 8 hour shifts of 100 workers each, the Workers on Main Shift value is 100. For many hotels, this number will vary seasonally. Hotels should estimate the average number for the year. Accurate ratings can be determined for Hotels that estimate the number of workers within 20%.
 - i. *Note that EPA is not adding any % for accuracy to other space types; this is unique for hotels which are characterized by different usage patterns.*
- b. Note – This is a new variable for the Hotel model. Also, the definition differs from other space types, due to greater variability in this number for a hotel.
- c. Model Calculation – The model uses the natural log of worker density (the number of workers per 1,000 square foot) to predict source EUI at a hotel.
- d. Verification Question – Does this number represent the average number of workers that are present during the primary shift (that is, the shift with the most workers)? Note: this is not the total number of staff employed at the property. For example, if there are three daily 8 hour shifts of 100 workers each, the

Workers on Main Shift value is 100. For many hotels, this number will vary seasonally. Hotels should estimate the average number for the year. Accurate ratings can be determined for Hotels that estimate the number of workers within 20%.

4. Number of Commercial Refrigeration/Freezer Units

- a. Definition – This number should be a count of all commercial-type refrigeration and freezer units at the hotel. This count should include all walk-in refrigeration/freezer units, which may be used in cooking areas to support restaurants, banquet areas, and conference facilities. This count should also include any open or closed refrigeration cases, which may be used to sell refrigerated goods to hotel guests (e.g. a display case with beverages). This count should not include ice makers, vending machines, or residential-type units that may be found in employee break rooms or guest rooms.
- b. Note – This is *not* the same as previous definitions used in the supermarket, retail, or K-12 School model. Rather, this is a different definition that combines Walk-in cases and open/closed cases.
- c. Model Calculation – The model uses the commercial refrigeration density (the number of refrigeration/freezer units per 1,000 square foot) to predict source EUI at a hotel.
- d. Verification Question: Does this count include all commercial-type refrigeration and freezer units at the hotel? This count should include all walk-in refrigeration/freezer units, which may be used in cooking areas to support restaurants, banquet areas, and conference facilities. This count should also include any open or closed refrigeration cases, which may be used to sell refrigerated goods to hotel guests (e.g. a display case with beverages). This count should not include ice makers, vending machines, or residential-type units that may be found in employee break rooms or guest rooms.

5. Presence of Cooking Facilities

- a. Definition – Does this hotel use energy for commercial or institutional cooking or food service on-site? Answer ‘Yes’ if this property includes cooking facilities to support room service, restaurants, conference space, and/or banquet facilities. Answer ‘No’ if the hotel’s food service consists only of continental breakfast service or other prepackaged or light offerings that do not require a full service kitchen. Answer ‘No’ if this property only includes equipment in employee break rooms, vending machines, and/or kitchens in guest suites.
- b. Note – The definition has been modified slightly for consistency with supermarket and other space types with cooking variables.
- c. Model Calculation – The model employs a yes/no variable to account for the presence of cooking facilities (1 for yes, 0 for no).
- d. Verification Question – Does this hotel use energy for commercial or institutional cooking or food service on-site? Answer ‘Yes’ if this property includes cooking facilities to support room service, restaurants, conference space, and/or banquet facilities. Answer ‘No’ if the hotel’s food service consists only of continental breakfast service or other prepackaged or light offerings that do not require a full

service kitchen. Answer 'No' if this property only includes equipment in employee break rooms, vending machines, and/or kitchens in guest suites.

6. Percent of the Gross Floor Area that is Heated

- a. Definition – This denotes the percent of the gross floor area that is served by mechanical heating equipment. The percent heated cannot be greater than 100%.
- b. Note – This percent heated attribute is similar to the percent heated attribute for supermarkets. The user should select from a dropdown menu, with options presented in bins of 10, from 0 through 100 (i.e. 0, 10, 20, 30...)
- c. Model Calculation – The model uses the product of the Heating Degree Days (HDD) and the percent heated to predict the source EUI at a hotel.
 - i. A value of 10% should appear in the model as 0.10
 - ii. Portfolio Manager should retrieve the actual, as experienced HDD value for the 12-month period of interest, using the building's zip code.
- d. Verification Question – Is this the percentage of the gross floor area that is served by mechanical heating equipment?

7. Percent of the Gross Floor Area that is Cooled

- a. Definition – This denotes the percent of the gross floor area that is served by mechanical cooling equipment. The percent cooled cannot be greater than 100%.
- b. Note – The percent cooled attribute is similar to the percent cooled attribute for supermarkets. The user should select from a dropdown menu, with options presented in bins of 10, from 0 through 100 (i.e. 0, 10, 20, 30...)
- c. Model Calculation – The model uses the product of the Cooling Degree Days (CDD) and the percent cooled to predict the source EUI at a hotel.
 - i. A value of 10% should appear in the model as 0.10
 - ii. Portfolio Manager should retrieve the actual, as experienced CDD value for the 12-month period of interest, using the building's zip code.
- d. Verification Question – Is this the percentage of the gross floor area that is served by mechanical cooling equipment?

Note on Percent Heated and Percent Cooled. Current dropdown fields in Portfolio Manager are stored as text. Hence, they display: 0, 10, 100, 20, 30, 40... etc. EPA would like to change this so that the percents are stored as numbers. Therefore, they should display: 0, 10, 20, 30, 40...etc through 100 at the end.

During the 10/9/08 meeting we agreed that this is feasible for the February release. This change will be made for All drop down menus with these options (e.g. for schools, medical offices, supermarket, etc)

Optional attributes

There will be **two** optional attributes. These are the same optional attributes that already exist in Portfolio Manager. However, there will be a slight modification to information that is collected.

1. Does this hotel process its laundry on-site?

- a. Definition – Does this property have an on-site facility for the production processing of laundry? Please select from the dropdown menu to indicate the level of laundry service performed at the hotel. Do not count coin operated machines for guest use or laundry machines used only for staff (e.g., uniforms).
 - i. No laundry facility
 - ii. Linens only (e.g., bed/table linens)
 - iii. Terry only (e.g., towels, bathrobes)
 - iv. Both linens and terry
- b. Note – This is a *modification of the existing variable and definition* to provide greater detail about the laundry facilities, if they are present. Each choice should be presented in a dropdown menu. Users should be *restricted to selecting one (1) option only*.
- c. Verification Question: Does this property have an on-site facility for the production processing of laundry? Please select from the following to indicate the level of laundry service performed at the hotel: No laundry facility; Linens only (e.g., bed/table linens); Terry only (e.g., towels, bathrobes); Both linens and terry. Note, do not count coin operated machines for guest use or laundry machines used only for staff (e.g., uniforms).

2. Average Occupancy

- a. Definition – The average occupancy should represent the average percentage of rooms that are occupied in the hotel during the course of a year.
- b. Note – There is a slight change to the definition, to make it a full sentence.
- c. Verification Question: Has the property maintained an average *vacancy of less than* 45% across the 12 month period being assessed?
 - i. *Note that the label process will be unchanged, where a question is still asked as to the vacancy rate for the hotel. We will continue to ask the same question and impose the same requirement, independent of how the user has answered this optional question.*

Attributes to be removed

EPA is not removing any attributes per se. However, there will no longer be separate hotel amenity categories. There will be one category, Hotel.

Default values

Default values should be available for all required attributes except Gross Floor Area. The default values are listed in **Table 1**. The defaults for Number of Rooms, Workers on Main Shift, and Number of Commercial Refrigeration/Freezer Units are computed based on weighted average values in the CBECS population. The defaults for Presence of Cooking Facilities, and Percent Heated and Percent Cooled are based on the most common responses in the CBECS population. Note that default values are not available for the optional attributes.

Table 1 Default Values for Required Hotel Attributes		
Required Attribute	Default Value	Notes
Gross Floor Area	NA	Defaults for size are not permitted in any modeling equation
Number of Rooms	1.95 Rooms per 1,000 square foot	Compute default value as: Number of Rooms = 1.95*(Gross Square Foot/1,000) <i>Density value is used in equation; no number is displayed to user.</i>
Workers on Main Shift	0.32 Workers per 1,000 square foot	Compute default value as: Workers on Main Shift = 0.32*(Gross Floor Area/1,000) <i>Density value is used in equation; no number is displayed to user.</i>
Number of Commercial Refrigeration/Freezer Units	0.023 Units per 1,000 square foot	Compute default value as: Commercial Units = 0.023*(Gross Floor Area/1,000) <i>Density value is used in equation; no number is displayed to user.</i>
Presence of Cooking Facilities	No	Assign a value of No (0) for cooking facilities
Percent Heated	100%	Assign a default value of 100% heated
Percent Cooled	100%	Assign a default value of 100% cooled

Recode values for existing hotels

In this revision EPA is effectively creating a new space, *Hotel*, which will replace the five existing hotel/motel models. This new space will include some variables that are in all or some of the existing models. Also, this space will add new variables, to accommodate the new modeling equation. ***Existing hotels in Portfolio Manager should not be assigned the standard default values for all of the new variables. For some variables,*** EPA has developed recoding instructions to provide the most accurate adjustments for these buildings based on information that has already been entered. Recoding for the existing buildings should proceed as follows:

- Gross Floor Area** – Buildings should be assigned the current floor space they have entered into their existing hotel amenity category.
 - That is, use the current value.*
- Number of Rooms** – Buildings should be assigned the current value for number of rooms that they have entered into their existing hotel amenity category.
 - That is, use the current value.*
- Workers on Main Shift** – Buildings should be assigned a default value of 0.32 Workers per 1,000 square foot.
 - That is, use the default value and mark as default.*
- Presence of Cooking Facilities** – Buildings should be assigned according to their current amenity category and/or response (*That is, use the current value*):

- a. Economy, Upscale, and Upper Upscale – Hotels in these categories currently answer the question “Does Cooking Occur on-Site”. The current response to this question (yes/no) should be assigned for Presence of Cooking Facilities.
 - b. Mid-scale without Food and Beverage – Hotels in this category should be assigned No for Presence of Cooking Facilities.
 - c. Mid-scale with Food and Beverage – Hotels in this category should be assigned Yes for Presence of Cooking Facilities.
 - d. *Note, effectively this is using the current value; therefore we do not need to mark as temporary or default.*
- 5. Number of Commercial Refrigeration/Freezer Units** - The number of commercial units will be based on whether or not the hotel has cooking facilities (as determined by Item 4). *These are new computed values (not defaults). They should be computed, reported as whole numbers and marked as temporary.*
- a. Hotels with Cooking – If the hotel has cooking facilities then it should be assigned 0.068 units per 1,000 square foot.
 - i. This value is computed as $0.068 * \text{Gross Floor Area} / 1,000$
 - ii. Round to the nearest whole number
 - b. Hotels without Cooking – If the hotel does not have cooking facilities then it should be assigned 0.016 units per 1,000 square foot.
 - i. This value is computed as $0.016 * \text{Gross Floor Area} / 1,000$
 - ii. Round to the nearest whole number
- 6. Percent of Gross Floor Area that is Heated** – Buildings should be assigned a default value of 100% heated.
- a. *That is, use the default value and mark as default.*
- 7. Percent of Gross Floor Area that is Cooled** – Buildings should be assigned a default value of 100% cooled.
- a. *That is, use the default value and mark as default.*
- 8. Does this hotel process its laundry on-site?** – Buildings should be assigned a default value based on their current response:
- a. Yes – These buildings should be defaulted to “Both linens and terry”
 - b. No – These buildings should be defaulted to “No laundry facility”
 - c. No Response – These buildings should be left with no response
 - d. *Note, effectively this is using the current value; therefore we do not need to mark as temporary or default.*

II. Model Format and Coefficients

The new Hotel model variables and coefficients are presented in **Table 2**. The new Hotel model is computed in a Source Energy Intensity (Source EUI) format, similar to the supermarket model released in July 2008. The lookup table is computed and presented in terms of energy efficiency ratios: Actual Source EUI/Predicted Source EUI. The lookup table is presented in Section VII.

Section III details specific procedures for computing the energy performance rating using the modeling equation.

Table 2
Summary of Coefficients and Centering Terms for the revised Hotel Benchmark Model

Variable Name	Variable Definition	Variable Coefficient	Reference Centering Value
Constant	Regression Intercept	169.1	NA
RoomDen	Room Density (Number of Rooms per 1,000 square foot)	33.22	1.951
LNWkrDen	Natural Log of Worker Density (LN(Number of Workers per 1,000 square foot))	20.80	-1.395
FDRM8	Presence of Cooking Facilities (0 for No, 1 for Yes)	65.14	NA
RfgCommDen	Commercial Refrigeration Density (Number of units per 1,000 square foot)	249.8	0.0227
HDDxPH	Heating Degree Days times Percent Heated	0.0107	4120
CDDxPC	Cooling Degree Days times Percent Cooled	0.0168	1224
<p><i>Note:</i></p> <ul style="list-style-type: none"> - HDD and CDD should be the actual, as-experienced values for the 12 month period (not 30-year averages) - Percent Heated and Percent Cooled appear in the equation as fractions between 0 and 1. - The reference centering term for Natural Log of Worker Density is negative - There is no reference centering term for the binary variable FDRM8 - The number 8 indicates that the CBECS 2003 survey is the 8th CBECS survey. 			

The variables and coefficients presented in **Table 2** are combined to compute the Source EUI according to the following equation:

$$\begin{aligned}
 \text{Predicted Source EUI (kBtu/ft}^2\text{)} = & 169.1 \\
 & + 33.22 * (\text{RoomDen} - 1.951) \\
 & + 20.80 * (\text{LNWkrDen} - (-1.395)) \\
 & + 65.14 * (\text{FDRM8}) \\
 & + 249.8 * (\text{RfgCommDen} - 0.0227) \\
 & + 0.0107 * (\text{HDDxPH} - 4120) \\
 & + 0.0168 * (\text{CDDxPC} - 1224)
 \end{aligned}$$

III. Procedures to Compute Energy Performance Ratings

The following procedures should be used to compute energy performance ratings for buildings with Hotels. These procedures should be the same as those used for the Retail, Office, Supermarket, and K-12 School models.

Procedure to rate a building that consists of one Hotel space only

1. Calculate the predicted Source EUI in kBtu/ft² using the equation presented in Section II

2. Calculate the total Predicted Source Energy
 - a. Predicted Source Energy = predicted Source EUI * floor space
 - b. Floor space in this equation should be the same time weighted floor space as was used to generate the predicted Source EUI.
3. Compute the Actual Source Energy from the metered data.
 - a. This total should be equal to 12 months worth of energy data.
 - b. This actual value should **not** be weather normalized.
 - c. This total should reflect the source energy conversion factors introduced on 10/1/2007, documented at:
http://www.energystar.gov/ia/business/evaluate_performance/site_source.pdf
 - d. Please note that a building with at least 11 months of data but less than 12 months of data should use an extrapolated value to express the full 12 month period. Buildings with fewer than 11 months of data should receive NA for the rating.
4. Calculate the energy efficiency ratio
 - a. Efficiency ratio = Actual Source Energy / Predicted Source Energy
5. Lookup the energy efficiency ratio in the lookup table
 - a. Refer to Section VII for direction on how to read the lookup table

Procedure to rate a building that contains multiple Hotel spaces

1. Combine all Hotel spaces into a single space. Attributes should be combined as follows:
 - a. Gross Floor Area: the square foot should be added across all Hotel spaces.
 - b. Number of Rooms: the number of rooms should be added across all Hotel spaces.
 - c. Workers on Main Shift: the number of workers should be added across all Hotel spaces.
 - d. Number of Commercial Refrigeration/Freezer Units: the total number of units should be added across all Hotel spaces.
 - e. Presence of Cooking Facilities: If **any** of the Hotel spaces have entered yes, then the answer to this question should be yes.
 - f. Percent Heated: The average percent heated should be computed across all Hotel spaces and *weighted by floor area*.
 - i. For example: there are two spaces: one is 10,000 square foot and 50% heated; the other is 20,000 square foot and 100% heated. The average percent heated should be: $0.5 \times (10,000/30,000) + 1.0 \times (20,000/30,000) = 0.833$. The combined space is 83.3% heated.
 - g. Percent Cooled: The average percent cooled should be computed across all Hotel spaces and *weighted by floor area*.
 - i. For example: there are two spaces: one is 10,000 square foot and 80% cooled; the other is 20,000 square foot and 100% cooled. The average percent cooled should be: $0.8 \times (10,000/30,000) + 1.0 \times (20,000/30,000) = 0.933$. The combined space is 93.3% cooled.
2. Compute the necessary model variables across the combined Hotel space
 - a. For example, compute LN(WorkerDensity) as:
 $\text{LN}\{1,000 \times (\text{Workers on Main Shift from 1.c}) / (\text{Gross Floor Area from 1.a})\}$
3. Compute the predicted Source EUI in kBtu/ft² according the equation presented in Section II; use the values obtained in Steps 1 and 2, above.

4. Calculate the total Predicted Source Energy
 - a. Predicted Source Energy = predicted Source EUI * floor space
 - b. Floor space in this equation should be the same time weighted floor space as was used to generate the predicted Source EUI.
5. Compute the Actual Source Energy from the metered data.
 - a. This total should be equal to 12 months worth of energy data.
 - b. This actual value should **not** be weather normalized.
 - c. This total should reflect the source energy conversion factors introduced on 10/1/2007, documented at:
http://www.energystar.gov/ia/business/evaluate_performance/site_source.pdf
 - d. Please note that a building with at least 11 months of data but less than 12 months of data should use an extrapolated value to express the full 12 month period. Buildings with fewer than 11 months of data should receive NA for the rating.
6. Calculate the energy efficiency ratio
 - a. Efficiency ratio = Actual Source Energy / Predicted Source Energy
7. Lookup the energy efficiency ratio in the lookup table
 - a. Refer to Section VII for direction on how to read the lookup table

Procedure to rate a building that contains a Hotel and another primary space

1. Calculate the predicted Source EUI in kBtu/ft² for the Hotel, using the equation presented in Section II.
2. Calculate the Predicted Source Energy for the Hotel
 - a. Predicted Source Energy = predicted source EUI * floor space
 - b. Floor space in this equation should be the same time weighted floor space as was used to generate the predicted Source EUI.
3. Calculate the total Predicted Source Energy for the other space
 - a. For a Retail, Office, Bank/Financial, Courthouse, Supermarket, or K-12 School space this will require computing a predicted Source EUI and then using the time weighted floor space to translate the predicted EUI into a Predicted Source Energy.
 - b. For Medical Office, Dormitory, and Warehouse (refrigerated/not), this will require computing a predicted LN(Source Energy), and then using exponential function, *e*, to convert the prediction into units of Source Energy.
 - c. Note that the Hotel space cannot be combined with Wastewater Treatment Plant, Water Distribution Facility, or Hospital.
4. Calculate the Predicted Source Energy for the building by adding together the predicted source energy for each space, obtained in Steps 2 and 3.
5. Create a combined lookup table for the building. There are two options for this step. They are both presented below and they are mathematically equivalent. SRA should determine the method that allows for the most streamlined computation within Portfolio Manager and Target Finder.

Note that SRA currently uses Option A, but will consider Option B for the summer of 2009.

- a. *Option A – Add Across in Units of Source Energy*

- i. For each space with a LN(Source Energy) model format (e.g. dormitory), PM already computes a unique lookup table in units of Source Energy.
- ii. For each space with a Source EUI model format (e.g. supermarket, office, retail), there is a lookup table of energy efficiency ratios. This table can be converted into units of source energy by multiplying each ratio by the predicted energy intensity and the time weighted floor space of the building. **Table 3** presents example calculations to convert the efficiency ratios into Source Energy values for both the Hotel and Office space types.
- iii. The combined lookup table adds across the source energy at each score. **Table 3** illustrates an example combined source energy calculation for an example building that is part office and part Hotel.

Table 3					
Example Ratings for a Combined Lookup Table in Source Energy (kBtu)					
Rating	Hotel Space		Office Space		Combined Source Energy
	Ratio	Source Energy (kBtu)	Ratio	Source Energy (kBtu)	
95	0.5060	22,264,000	0.435548	4,355,480	26,619,480
75	0.7350	32,340,000	0.691894	6,918,940	39,258,940
40	1.0303	45,333,200	1.041511	10,415,110	55,748,310
<i>Note</i> - For this example the Hotel has a predicted EUI of 220 kBtu/ft ² and a gross floor area of 200,000 ft ² - For this example the Office has a predicted EUI of 200 kBtu/ft ² and a gross floor area of 50,000 ft ²					

- b. *Option B – Combined Lookup Table of Efficiency Ratios* (only available for spaces with EUI models, listed under 3.a)
 - i. For space types that have an EUI based format, Option A is mathematically identical to creating a combined lookup table of energy efficiency ratios where the ratios at each rating value are added together ***and weighted by the percent of the predicted source energy***
 - ii. For the example in **Table 3** (above): the predicted source energy for the Hotel is equal to: $220 \times 200,000 = 44,000,000$ kBtu. The source energy prediction for the office is equal to: $50,000 \times 200 = 10,000,000$ kBtu. Hence, the total predicted source energy is equal to: $44,000,000 + 10,000,000 = 54,000,000$ kBtu.
 - iii. For the example in **Table 3**, the Hotel space accounts for 81.48% of the total source energy prediction ($44,000,000/54,000,000$); the office space accounts for 18.52% of the total source energy prediction ($10,000,000/54,000,000$).
 - iv. **Table 4** presents the lookup table values for selected ratings for the same example building as in **Table 3**, but in energy efficiency ratios rather than source energy units.

Table 4 Example Ratings for a Combined Lookup Table of Efficiency Ratios					
Rating	Hotel Space		Office Space		Combined Efficiency Ratio
	Ratio	Percent of total source prediction	Ratio	Percent of total source prediction	
95	0.5060	81.48%	0.435548	18.52%	0.4930
75	0.7350	81.48%	0.691894	18.52%	0.7270
40	1.0303	81.48%	1.041511	18.52%	1.0324
<i>Note</i> - For this example the Hotel has a predicted EUI of 220 kBtu/ft ² and a gross floor area of 200,000 ft ² - For this example the Office has a predicted EUI of 200 kBtu/ft ² and a gross floor area of 50,000 ft ²					

6. Calculate the Actual Source Energy for the building
 - a. This total should be equal to 12 months worth of energy data.
 - b. This actual value should **not** be weather normalized.
 - c. This total should reflect the source energy conversion factors introduced on 10/1/2007, documented at:
http://www.energystar.gov/ia/business/evaluate_performance/site_source.pdf
 - d. Please note that a building with at least 11 months of data but less than 12 months of data should use an extrapolated value to express the full 12 month period.
Buildings with fewer than 11 months of data should receive NA for the rating.
7. Look up the building rating in the lookup table created in Step 5
 - a. For **Option A**: Actual Source Energy (from Step 6) for the building can be looked up directly in the table
 - b. For **Option B**:
 - i. Compute the energy efficiency ratio for the building. The energy efficiency ratio is the actual source energy (from Step 6) divided by the predicted source energy (from Step 4).
 - ii. Lookup the energy efficiency ratio in the lookup table.

Procedure to rate a building that contains a Hotel and a secondary space

The methodology for incorporating a secondary space (i.e. Computer Data Center, Swimming Pool, and Parking Garage) with a Hotel should follow the standard procedures instituted on October 1, 2007.

Each secondary space has a predicted source energy use (or energy use per square foot). This prediction for the secondary space should be **subtracted** from the actual source energy consumption prior to computing and looking up the efficiency ratio (or, actual source energy, depending on the building) in the lookup table.

Per discussions prior to the October 1, 2007 release date, this methodology, on rare occasions can yield a negative value for the actual source energy consumption. This is not expected to be common. However, it is possible, especially in a theoretical net zero building, or a building that is not connected to the grid. If a negative value is obtained for the actual source energy, the

building should be assigned an actual source energy value of zero, and therefore the building should receive ***an energy performance rating of 100***. SRA should maintain a list of these buildings and their operating characteristics, and present this list to EPA on a quarterly basis.

Please note that the Pool calculation is also changing in February 2009. Details on these changes are provided under separate cover. However, they should be developed and integrated with the Hotel changes.

Procedure to rate a building with Other space

This procedure is unchanged relative to the standard protocol in Portfolio Manager. Generally, the standard protocol adjusts the look-up table upward by the percent of the floor area that is occupied by Other. Implicitly this assumes that the Other space will have about the same EUI as the rated space. Other cannot be used for more than 10% of a building.

Negative EUI predictions

With the methodology of predicted Source EUI, it is possible that a Hotel could receive a negative prediction. This is not expected and would only occur for an atypical combination of space attributes. If this occurs, Portfolio Manager should be programmed to assign a value of 1 kBtu/ft² for the predicted Source EUI, and the ***building should receive N/A as its rating***. The N/A message should read: The combination of space attributes falls outside the expected range for Hotels. SRA should maintain a record of any buildings that fall into this category, and present a list of these buildings to EPA on a quarterly basis. This list should include building ID, in addition to energy information and operating characteristics.

IV. Eligibility Requirements

As with other benchmarking models, there are two sets of eligibility requirements for the Hotel model: requirements to receive a rating; and requirements to earn the label. ***Note that eligibility requirements are applied once per space type. All hotel spaces in a single building should be added together. Then, the eligibility rules are applied.***

Eligibility to receive an energy performance rating

Four conditions must be met in order for a Hotel to earn an energy performance rating:

1. Gross floor area must be at least 5,000 square foot (i.e. floor area $\geq 5,000$)
2. There must be at least 1 room
3. There must be at least 1 worker
4. There must be a non-negative value for Commercial Refrigeration/Freezer units (i.e. number of units ≥ 0)

Any building that fails to meet one of these requirements should receive NA for its rating. SRA should incorporate these requirements with the eligibility criteria on the website

(http://www.energystar.gov/index.cfm?c=eligibility.bus_portfoliomanager_eligibility). Updating the website will also include incorporating these criteria into the posted PDF table of eligibility criteria for all spaces

(http://www.energystar.gov/ia/business/evaluate_performance/OperatingCharacteristics.pdf).

These revisions will include removing the current hotel amenity category room number requirements. Those requirements are no longer relevant. They currently appear in a dedicated table in the PDF document and as Item 9 on the website. These references must both be eliminated.

We determined that SRA will be responsible for maintaining the current version of the eligibility PDF and for updating it with new releases, as needed.

Although not enumerated above, it is also required that a user provide a response for Presence of Cooking, Percent Heated, and Percent Cooled. These variables have fixed options from Portfolio Manager. Hence, it is not possible to put in a value that is out of bounds. However, when a user creates a Hotel, they must answer these questions. If they do not, they should see an error message when they click "Save". The error message should read: Attribute value must be entered. *This is already the standard requirement in Portfolio Manager.*

Eligibility to earn a label

The following conditions should be flags for the purpose of applying for the label. If a label application has values that fall outside of these ranges, the applicant should be prompted for a response. *It is okay to keep the Source EUI as an internal check at SRA, but the other prompts should occur electronically. For example, the Office space has electronic prompts for the number of hours and the number of workers.*

1. Room Density should not be
 - a. Greater than 4 rooms per 1,000 square foot
 - b. Less than 0.75 room per 1,000 square foot
2. Worker Density should not be
 - a. Greater than 1 worker per 1,000 square foot
 - b. Less than 0.1 worker per 1,000 square foot
3. Commercial Refrigeration/Freezer density should not be
 - a. Greater than 0.3 units per 1,000 square foot
4. Source EUI should not be
 - a. Less than 30 kBtu/ft²
 - b. Greater than 300 kBtu/ft²
 - c. Note that these Source EUI criteria are *changed from the current criteria, which are based on the hotel amenity category.*
5. *Vacancy rate should be less than 45%*
 - a. *This is a current rule which is applied through a question presented to users during the application process. This rule will be unchanged. The vacancy is determined based on the user response to the question during the label application (not based on the response to the optional field for occupancy).*

Note that there is no low end prompt for Commercial Refrigeration density. It is possible to have zero of these units.

V. Consistency Requirements

This document has been structured to detail the calculation requirements for benchmarking with the new model in Portfolio Manager. It does not cover an exhaustive list of all the places where the changes will apply. SRA will be expected to update the following areas of the tool and the web accordingly.

1. Portfolio Manager and Target Finder
2. Portfolio Manager/Target Finder Help Screens
3. Automated benchmarking services
4. Energystar.gov web content
 - a. Space definition and list of attributes
 - b. Eligibility criteria website
 - c. Eligibility criteria PDF file
 - d. References to Hotels and/or to old Hotel amenity categories on the web
 - e. Hotel Technical Description (new document to be provided by EPA)
5. Data Checklist (prints with SEP)

If SRA identifies areas of the tool that will require additional content and language, EPA will work with SRA to ensure that appropriate content is developed. EPA expects that SRA will search PM and the Web to identify places that may be impacted by these changes.

VI. Model Testing and Score Change Report

EPA will require a score change report (in Excel) in order to test the new model, verify SRA scripts, and prepare the hospitality outreach team for expected rating changes. This score change report should be similar to the report created for the July 2008 supermarket changes. This means that all buildings in Portfolio Manager that contain a hotel space should be included in the report. Please ***refer to the separate Score Change Report document*** for a complete list of desired column headings (metrics) to be included in the report.

It is EPA's intention that the information contained in this report will provide all required fields so that the ratings can be completely replicated. If SRA has any questions or identifies any missing elements, it would be useful if they could alert EPA prior to generating the report. This way, the report should be complete the first time it is created.

The sample should be drawn to include all buildings that:

1. Have a rating
2. Are not labeled "Test" or "Sample"
3. Are not owned by EPA or its contractors
 - a. Note that in the Supermarket score change report, there were two buildings owned by Sara Lisauskas. Sara is a contractor at ICF. Her buildings should have been filtered out to meet this requirement. (Building IDs: 1054448 and 1054453)

4. Have at least one Hotel space
 - a. The hotel space does not have to be 50% or more of the floor area. EPA wants to review all buildings with hotel space.

In addition, please note the following:

1. The pool and K-12 School models are also schedule to change on **February 23**, 2009. Hence, the ***new ratings in the score change report should reflect the Hotel, K12 School, and Pool changes***. A building with a hotel and a pool should have its new rating computed with the new hotel model and the new pool model.
 - a. EPA has requested separate reports to analyze the pool and school changes.
2. ***The list of desired column headings is presented in the separate 3 page score change report document. Please note that some items have been added/removed from the report from previous versions to make it as valuable as possible.*** For example, EPA has added new fields for:
 - a. The most recent label year
 - b. The use of 30 year weather data
 - i. A yes/no variable to indicate whether the 30-year average HDD and CDD are used. Although this is not the standard procedure it does occur when actual data is missing. Therefore, to replicate ratings, EPA needs to know if these averages were used.
 - c. All optional attributes (as well as required attributes)
 - d. The current period ending data
 - e. The date that the building was last updated
3. The list of desired column headings includes all of the old values for the hotel spaces (e.g. the old hotel amenity category), in addition to all of the new hotel attributes. ***As noted in Section 1, the existing Hotels in Portfolio Manager should not receive the standard defaults, but will received special recodes based on their current values.***
4. All numbers should be displayed/stored as numbers (not as text/strings)
5. All yes/no variables (for example Presence of Cooking) should be displayed as either 1 or 0 (for Yes or No). Please do not display these as coefficient values.
6. All attribute values (including square foot) should be presented as the time-weighted attribute values that are used to predict the Source EUI for the building.
7. The attribute values for non-Hotel spaces (e.g. Office, Retail) should only be included if the sample contains a building with that space. (e.g. if there are no buildings in the sample that contain supermarkets, then there is no need for any supermarket attribute columns).
8. Percent Heated/Percent Cooled should be reported as fractions between 0 and 1 (i.e. the values that are used in the equations). Note that all hotels are being defaulted to 100% (i.e. 1). Hence, this request will only apply to other spaces that may be present (e.g. Retail).
9. The “count of primary spaces” should reflect the total number of spaces, ***not*** the total number of space types. For example, a building with 5 hotel spaces has 5 primary spaces (not 1).

VII. Lookup Table

Table 6 presents the lookup table for the new Hotel benchmarking model. This table lists energy efficiency ratios. It should be read as follows:

- If the ratio is less than 0.3559, the hotel should receive a 100
- If the ratio is greater than or equal to 0.3559 but less than 0.4047, the hotel should receive a 99.
- If the ratio is greater than or equal to 0.4047 but less than 0.4380, the hotel should receive a 98.
- If the ratio is greater than or equal to 1.7987 but less than 1.9417, the hotel should receive a 2.
- If the ratio is greater than or equal to 1.9417, the hotel should receive a 1.

Table 6 Hotel Lookup Table						
Rating	Cumulative Percent	Ratio		Rating	Cumulative Percent	Ratio
100	0%	0.3559		50	50%	0.9422
99	1%	0.4047		49	51%	0.9507
98	2%	0.4380		48	52%	0.9592
97	3%	0.4643		47	53%	0.9678
96	4%	0.4865		46	54%	0.9765
95	5%	0.5060		45	55%	0.9852
94	6%	0.5236		44	56%	0.9940
93	7%	0.5396		43	57%	1.0030
92	8%	0.5546		42	58%	1.0120
91	9%	0.5685		41	59%	1.0211
90	10%	0.5817		40	60%	1.0303
89	11%	0.5943		39	61%	1.0397
88	12%	0.6063		38	62%	1.0492
87	13%	0.6179		37	63%	1.0588
86	14%	0.6290		36	64%	1.0686
85	15%	0.6398		35	65%	1.0786
84	16%	0.6503		34	66%	1.0887
83	17%	0.6605		33	67%	1.0990
82	18%	0.6704		32	68%	1.1096
81	19%	0.6801		31	69%	1.1203
80	20%	0.6897		30	70%	1.1313
79	21%	0.6990		29	71%	1.1425
78	22%	0.7082		28	72%	1.1540
77	23%	0.7173		27	73%	1.1658
76	24%	0.7262		26	74%	1.1779
75	25%	0.7350		25	75%	1.1903
74	26%	0.7438		24	76%	1.2031
73	27%	0.7524		23	77%	1.2163
72	28%	0.7609		22	78%	1.2300
71	29%	0.7694		21	79%	1.2442
70	30%	0.7778		20	80%	1.2589
69	31%	0.7861		19	81%	1.2742
68	32%	0.7944		18	82%	1.2902
67	33%	0.8027		17	83%	1.3070
66	34%	0.8109		16	84%	1.3245
65	35%	0.8191		15	85%	1.3431
64	36%	0.8273		14	86%	1.3628
63	37%	0.8354		13	87%	1.3837
62	38%	0.8436		12	88%	1.4061
61	39%	0.8517		11	89%	1.4303
60	40%	0.8598		10	90%	1.4567
59	41%	0.8680		9	91%	1.4856
58	42%	0.8761		8	92%	1.5179
57	43%	0.8843		7	93%	1.5545
56	44%	0.8925		6	94%	1.5969
55	45%	0.9007		5	95%	1.6477
54	46%	0.9089		4	96%	1.7115
53	47%	0.9172		3	97%	1.7987
52	48%	0.9255		2	98%	1.9417
51	49%	0.9338		1	99%	>=1.9417